



**American
Superconductor™**

REVOLUTIONIZING THE WAY THE WORLD USES ELECTRICITY™

Generator Fact Sheet

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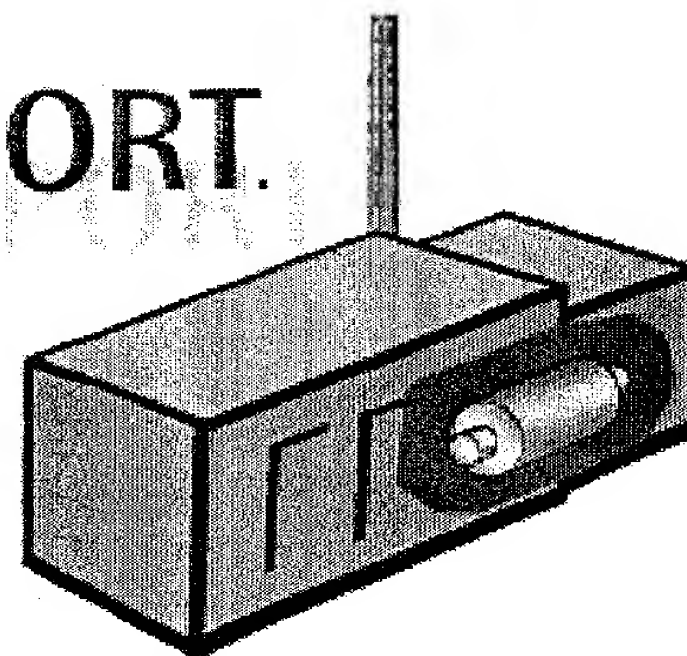
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With HTS technology, generators can provide **FAST, REACTIVE POWER SUPPORT.**

These new HTS generators help to keep the grid running smoothly in the face of new patterns of power flows being brought on by the deregulation of power generation throughout the world.



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HTS Generators

What is it?

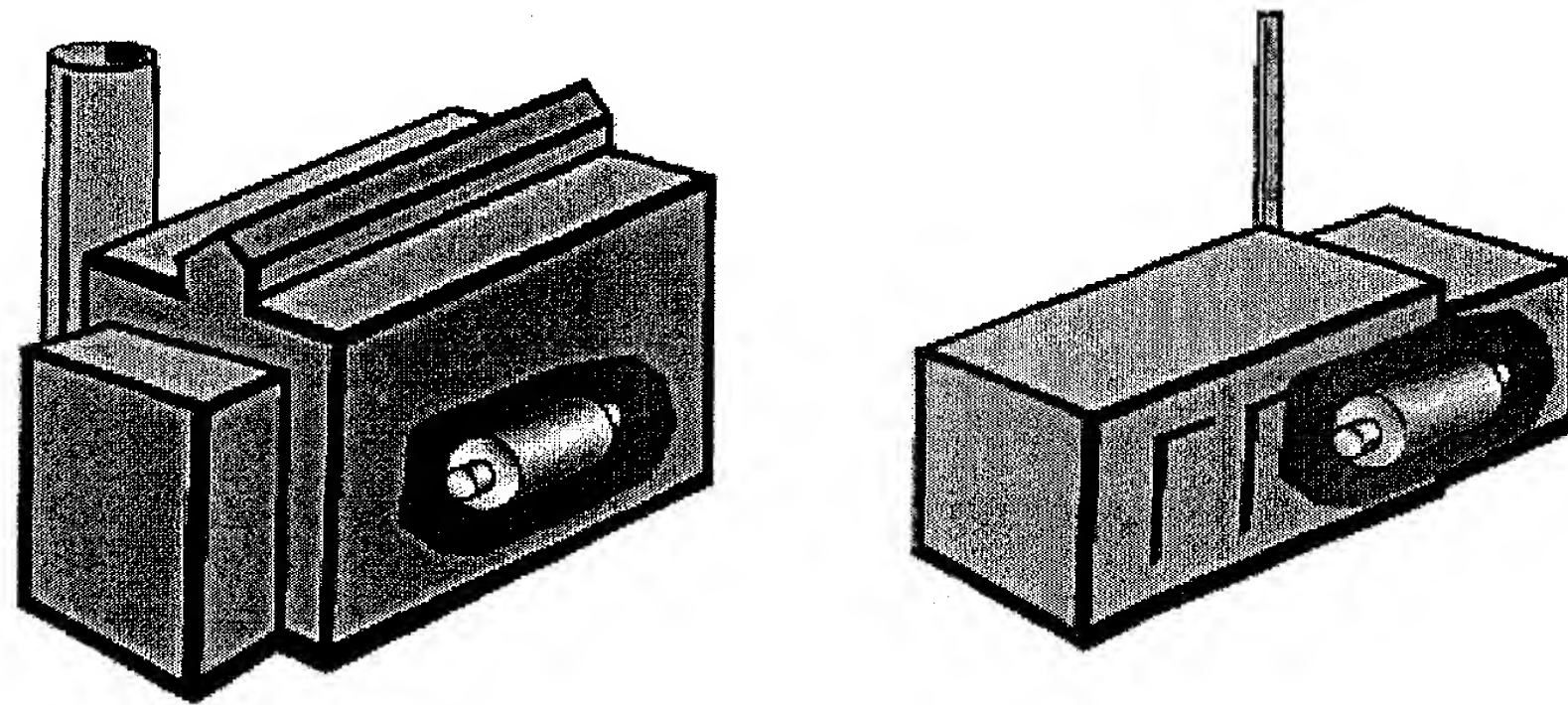
A generator converts rotational mechanical input energy, such as that from a steam or gas turbine, into electricity. It does this by rotating a rotor field, which produces voltage in stationary armature conductors. The generator field can be produced with copper windings or permanent magnets. In large machines, mechanical considerations and the desire to vary the level of field produced typically favor the use of copper windings over permanent magnets.

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Where and how are they used?

The primary application would be utility generation facilities, using

either new or retrofitted generators. Retrofitting would be more likely in established industrial nations, while developing nations could benefit from new generators using HTS technology.



Retrofit factory with HTS generator New factory with HTS generator

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What is the market potential?

Generators represent a large, established worldwide market. Growth projections forecast that more than 1000 GW of new generation capacity will be needed in the next 10 years, 173 GW in the US. EPRI's Superconductivity Partnership Initiative estimates the worldwide generator market for this period is \$23-30 billion.

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What are the benefits?

- Increase machine efficiency beyond 99%, reducing losses by as much as 50% over conventional generators
- Energy savings
- Reduced pollution per unit of energy produced
- Lower life-cycle costs
- Enhanced grid stability
- Reduced capital cost
- Reduced installation expenses

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What are the advantages of HTS generators?

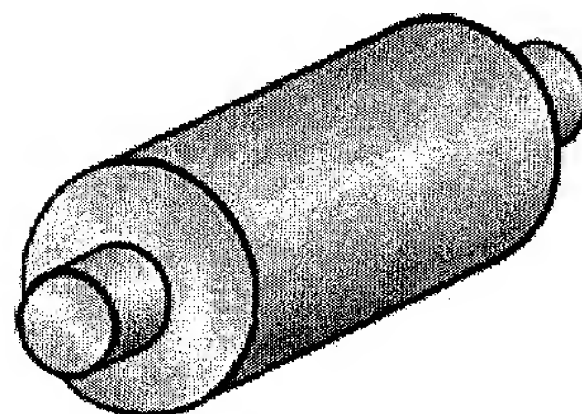
- **Efficiency Gains**

Generators lose power in the rotor windings and in the armature bars. By using superconducting wire for the field windings, these losses can be practically eliminated. The fields created in the armature by the rotor are not limited by the saturation characteristics of iron and the armatures are constructed without iron teeth. This removes the losses experienced in the armature teeth. The added space for copper in the armature made possible by the removal of the armature teeth further reduces losses.

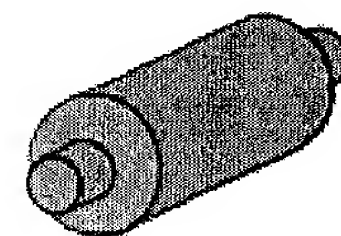
HTS generators will produce electric power with lower losses than their conventional equivalents. A 1,000 MW superconducting generator (a typical size in large power plants) could save as much as \$4 million per year in reduced losses per generator. Even small efficiency improvements produce big dollar savings. A half of one percent improvement provides a utility or IPP with additional capacity to sell with a related value of nearly \$300,000 per 100 MVA generator. The worldwide demand for additional electrical generation is ever increasing. The National Energy Information Center forecasts that the world will require 500,000 MW of additional electric generating capacity over the next ten years.

- **Smaller and Lighter**

An HTS generator will be 1/3 the overall volume of its conventional equivalent. For example, in power plants where expansion is difficult (e.g.: shipboard or locomotive power), superconducting generators could increase generating capacity without using additional space. Smaller, lighter HTS generators use an "air core" design, eliminating much of the structural and magnetic steel of a conventional equivalent. Construction, shipping, and installation are all simplified and less costly.



Conventional Generator



HTS Generator

- **System Impact**

A major benefit of HTS generators is lowered armature reactances. This benefit can profoundly impact utility stability

considerations. One implication is a reduction in the amount of spinning reserve (unused but rotating generating capacity) needed to insure a stable overall power system. Another benefit is that an HTS generator has the capability of being significantly overexcited to permit power factor correction without adding synchronous reactors or capacitors to the power system.

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American Superconductor
Two Technology Drive Westborough, MA 01581
Voice: 508-836-4200 | Fax: 508-836-4248
www.amsuper.com